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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	)
Ralf VIERICH et al.	) Group Art Unit: Unknown
Application No.: **10/624,490**	) Examiner: Unknown
Filed: July 23, 2003	)
For: PARAMETERIZED DATABASE DRILL-THROUGH	)

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

CLAIM FOR PRIORITY

Under the provisions of Section 119 of 35 U.S.C., Applicants hereby claim the benefit of the filing date of Canadian Patent Application Number 2,394,514, filed July 23, 2002, for the above-identified United States Patent Application.

In support of Applicants' claim for priority, a certified copy of the priority application is filed herewith.

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, L.L.P.

Dated: March 1, 2004

By: _____
Ernest F. Chapman

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This is to certify that the documents attached hereto and identified below are true copies of the documents on file in the Patent Office.

Specification and Drawings, as originally filed, with Application for Patent Serial No: **2,394,514**, on July 23, 2002, by **COGNOS INCORPORATED,** assignee of Ralf Vierich and Kevin Ferguson, for "Method and System for Parameterized Database Drill-Through".

Agent certificateur/Certifying Officer

August 21, 2003

Date

Canada

OPIC CIPO

Abstract of the Disclosure

A database interface for generating drill-throughs of various data cubes, derived from different report generating applications is disclosed. The interface comprises: (a) means for accepting a request from a user for data; (b) means for translating the request into a drill-through selected from a plurality of possible drill-through paths between a source and a target; (c) means for applying one or more parameters to the selected drill-through path to produce a valid drill-through path and to transfer the requested data over the valid drill-through path to an application; and (d) display means for displaying the requested data to the user.

Method and system for parameterized database drill-through

Field of the Invention

The present invention relates to methods, apparatus and systems for interactively searching a database in such a manner that it is quick and easy to search, drill down, drill-up and drill across a data collection presenting the user with summary information using multiple independent hierarchical category taxonomies of the data collection. The present invention also relates to retrieving information from a database based on content aggregation, management and distribution.

Background of the Invention

The field of business applications of computer technology has seen many important changes over the last few years. With steadily growing computational power and data storage capacities of computer systems used for business data processing, the interest of the business community has shifted from transactional data management systems (on-line transaction processing systems, or OLTP systems, mostly supporting day-to-day business operations) and from relatively simple business data processing systems, towards sophisticated business management systems, such as business intelligence (BI) systems, integrating at the enterprise level many facets and functions of the business, including planning, manufacturing, sales and marketing.

Among various alternative approaches to business data management and analysis developed over the last few years, many are related to data warehousing. A data warehouse can be defined broadly as a subject-oriented collection of business data identified with a particular period of time, as opposed to transactional databases which are dedicated to ongoing business activities. Data in a warehouse is normally gathered from a variety of sources (mostly various OLTP and legacy systems) and merged into a coherent whole. Data in a warehouse is usually stable, with data being added to the warehouse periodically but usually not removed. In some cases the oldest data is unloaded when the newer data is added.

As opposed to data stored in OLTP systems intended to support day-to-day operations and optimized for the speed and reliability of transaction updating, data stored in a data warehouse is intended to provide higher-level, aggregated views of the data,

such as total sales by product line or region over a predetermined period of time, in support of business decision making. To provide consistently fast responses to such aggregate queries, data in a data warehouse or data mart must be structured in a manner facilitating the data synthesis, analysis, and consolidation.

The most characteristic feature of warehoused business data is its multidimensional view of a business, so-called because the business data is organized according to major aspects and measures of the business called dimensions, such as its products, markets, profits, or time periods involved, as opposed to data dependencies model of the business data, which keeps track of all logical relationships among all the possible data elements relevant to the business and its day-to-day operations. A dimension may include several hierarchical levels of categories, for example the market dimension may contain, in descending order, such categories as country, region, state, and city, each category having its own number of specific instances. A hierarchical dimension reduces the total number of dimensions necessary to describe and organize the data, as compared with the situation where each category is represented by a separate dimension. The action of viewing data in greater detail by moving down the hierarchy of categories, i.e., by moving from parent to child category, is sometimes referred to as "drilling down" through the data. Quite naturally, the action of moving in the opposite direction, i.e., up the hierarchy of categories, to produce a more consolidated, higher-level view of data, is known as "drilling up" through the data. Another aspect of this 'drilling' is the ability to 'drill through' from one form of data to another where the data are collected in reports having different meta-data models or data sources, but where the actual data are compatible (or able to be converted to a compatible form) for use in an application. This is further discussed below.

The vast amounts of warehoused or otherwise collected business data would be useless without software tools for its analysis. Such tools are known under the collective name of Business Intelligence (BI) applications, an example of which is a suite of BI applications from Cognos Inc. (Canada). BI applications provide, among others, data warehouse construction tools, as well as database querying, navigation and exploration tools, the latter including, among others, reporting, modeling, and visualization tools. Some of these tools combine new ways of data analysis and presentation with methods

for discovering hidden patterns and previously unrecognized relationships among data, an approach sometimes known as data mining.

Among BI applications made available to the business community over the last few years, tools for visualizing business data are of particular importance. By interacting with the user graphically or pictorially, these tools have become means of choice for consolidating and presenting vast amounts of complex information, in the manner which facilitates pattern recognition in the presented data and invites data exploration.

In order to fully exploit the data, a number of concepts have evolved including that of 'drilling'. 'Drill-down', to obtain more detail, and 'drill-up', to lessen the detail, are well-known examples, and a further version, 'drill-through' is becoming increasingly used. Drill-through is defined as the action of navigating from one report or dataview to another report or dataview and applying the context of the source to the target.

For example when invoking a drill-through operation from a row of the source report to a target report, a filter is constructed based on the source report row and the filter is then applied to the target report. This filter is then used by an application in requesting data from another application.

Using earlier technology it is necessary to apply some very strict rules in order to effectively drill from one application to another. The drill-through filter generated from the drill-through source is required to match up with the column names used in the target report. This column name matching is typically done through a set of intermediate files called query definitions (QDs). A QD file is essentially the sql query that can be used by a transformation program to generate a new data cube. The QD file contains the column name mapping used to generate the context filter that the target application can understand. The process is duplicated for each source/target application pair, although in each case the intermediate files may have slightly different formats, but they still served as a column name map.

The following terms will be used throughout this application:

Business Intelligence Tools: Software that enables business users to see and use large amounts of complex data. The following three types of tools are referred to as Business Intelligence Tools: Multidimensional Analysis Software - also known as Online Analytical Processing (OLAP) - Software that gives the user the opportunity to look at

the data from a variety of different dimensions. Query Tools - Software that allows the user to ask questions about patterns or details in the data. Data Mining Tools - Software that automatically searches for significant patterns or correlations in the data.

Cube (also known as Multidimensional Cube): The fundamental structure for data in a multidimensional (OLAP) system. A cube contains dimensions, hierarchies, levels, and measures. Each individual point in a cube is referred to as a cell.

Data-Based Knowledge: Knowledge derived from data through the use of Business Intelligence Tools and the process of Data Warehousing that give us a new kind of knowledge based on data. Data-based knowledge can have several advantages compared to experience/intuition-based knowledge: Accuracy because it is based on so many detailed facts. More current because the data warehousing and business intelligence tools can so quickly analyze new data. More comprehensive because so many different perspectives are available through the rapid recombination of elements from different dimensions and different levels of the data hierarchy. New insights are possible because there are complex patterns in the data that can be discovered by data mining that would never be detected by human analysis. Less subjective because conclusions are tied directly to the physical data.

Dimension: One of the perspectives that can be used to analyze the data in an OLAP cube. When browsing the data in a cube, it is possible to view the data from the perspective of different combinations of dimensions. For a Sales database, the dimensions might include Product, Time, Store, and Promotion. Dimensions contain one or more hierarchies, which have levels for drilling up and drilling down in the cube. When a dimension has just one hierarchy (which is quite common), people often refer to the dimension itself as having levels.

Hierarchy: Organization of data into a logical tree structure. Dimensions can have one or more hierarchies. A Time dimension, for example, might have a Calendar hierarchy and a Fiscal hierarchy. Hierarchies contain levels, which organize data in a logical structure. It is the combination of multidimensional data with a hierarchical view given by Business Intelligence Software that allows users to grapple successfully with large amounts of data. If each member in a level has 5 to 10 children that are members at

the next lower level, the user has a better chance of understanding the significance of the data. Moving between the levels of a hierarchy is called drilling up and drilling down.

Level: The hierarchies in dimensions have levels which can be used to view data at various levels of detail. A Time dimension might have levels for Year, Quarter, Month, and Day. A Product dimension might have levels for Product Family, Product Category, Product Sub-category, and Product Name. A Customer Geography dimension might have levels for Region, Country, District, State, City, and Neighborhood.

Member: One of the data points for a level of a hierarchy of a dimension. Some of the members of the Month level of the Time dimension are January, February, March, and April.

Measure: A numeric value stored in a fact table and in an OLAP cube. Sales Count, Sales Price, Cost, Discount, and Profit could all be measures in an OLAP cube.

Multidimensional Analysis - also known as On-Line Analytical Processing (OLAP): A process of analysis that involves organizing and summarizing data in a multiple number of dimensions. People can comprehend a far greater amount of information if that information is organized into dimensions and into hierarchies. The wide use of spreadsheets and graphs illustrates the need for people to have their information organized. A spreadsheet is a two-dimensional analysis tool. If a person could comprehend ten individual facts, they could possibly comprehend 100 facts if they were arranged in a spreadsheet. If three or four or five dimensions could be displayed, the amount of information that could be comprehended would be increased exponentially - to 1000 facts, 10,000 facts, and 100,000 facts. Multidimensional data is also organized hierarchically, allowing users to "drill down" for more detailed information, "drill up" to see a broader, more summarized view, and "slice and dice" to dynamically change the combinations of dimensions that are being viewed.

Summary of the Invention

The present invention is designed to overcome at least some of the problems found in earlier systems, and also provide other advantages as will be clear from the following description.

In the invention, a drill-through path is defined by a collection of parameters that map context elements from the drill-through source (report) to the inputs of the target. These parameters define the target/source mapping, and any translation, filtering, or formatting that may be required.

A parameter is a way of providing 'public' access to a column for external applications by giving it a name. More generally parameters define an input or output to a drill-through source or target. Additional parameters may be used to select and define conversion functions for the drill-through process so that the invention also acts as a means for defining a data converter or filter.

According to one aspect of the present invention, there is provided a database interface for generating drill-throughs of various data cubes, derived from different report generating applications. The interface comprises: (a) means for accepting a request from a user for data; (b) means for translating the request into a drill-through selected from a plurality of possible drill-through paths between a source and a target; (c) means for applying one or more parameters to the selected drill-through path to produce a valid drill-through path and to transfer the requested data over the valid drill-through path to an application; and (d) display means for displaying the requested data to the user.

According to anther aspect of the present invention, there is provided a computer-based method for obtaining data from one or more compatible data sources for use within applications implementing a decision support system. The method comprises the steps of: (a) in a business modeling tool before using a business intelligence application, modeling a mapping of data between a source and a target to produce one or more possible drill-through paths between the source and the target, each drill-through path having one or more parameters; in the business intelligence application, by using a report authoring tool, (b) accepting a request from a user for data; (c) translating the request into a drill-through selected from the possible drill-through paths between the source and the target; (d) applying one or more parameters to the selected drill-through path to produce a valid drill-through path and transferring the requested data over the valid drill-through path to an application; and (e) displaying the requested data to a user.

According to another aspect of the present invention, there is provided a computer-based system for obtaining data from one or more compatible data sources for

use within applications implementing a decision support system, the system comprising the steps of: (a) in a business modeling tool before using a business intelligence application, means for modeling a mapping of data between a source and a target to produce one or more possible drill-through paths between the source and the target, each drill-through path having one or more parameters; in the business intelligence application, by using a report authoring tool, (b) means for accepting a request from a user for data; (c) means for translating the request into a drill-through selected from the possible drill-through paths between the source and the target; (d) means for applying one or more parameters to the selected drill-through path to produce a valid drill-through path and to transfer the requested data over the valid drill-through path to the application; and (e) display means for displaying the requested data to a user.

According to another aspect of the present invention, there is provided an apparatus for obtaining data from one or more compatible data sources for use within applications implementing a decision support system. The apparatus comprises: a) in a business modeling tool, means for modeling a mapping of data between a source and a target to produce one or more possible drill-through paths between the source and the target, each drill-through path having one or more parameters, b) in the business intelligence application, by using a report authoring tool, i) means for accepting a request from a user for data, ii) means for translating the request into a drill-through selected from the possible drill-through paths between the source and the target, iii) means for applying one or more parameters to the selected drill-through path to produce a valid drill-through path and to transfer the requested data over the valid drill-through path to the application; and iv) display means for displaying the requested data to a user.

According to another aspect of the present invention, there is provided a computer executable software code stored on a computer readable medium, the code for obtaining data from one or more compatible data sources for use within applications implementing a decision support system. The code comprises: a) in a business modeling tool, code for modeling a mapping of data between a source and a target to produce one or more possible drill-through paths between the source and the target, each drill-through path having one or more parameters, b) in the business intelligence application, by using a report authoring tool, i) code for accepting a request from a user for data, ii) code for

translating the request into a drill-through selected from the possible drill-through paths between the source and the target, iii) code for applying one or more parameters to the selected drill-through path to produce a valid drill-through path and to transfer the requested data over the valid drill-through path to the application; and iv) code for displaying the requested data to a user.

A further understanding of other features, aspects and advantages of the present invention will be realized by reference to the following description, appended claims and accompanying drawings.

Brief Description of the Drawings

A preferred embodiment(s) of the invention will now be described with reference to the following figures:

Figure 1 shows the computer and related systems and connections within which the invention may be practiced;

Figure 2 shows a simple situation in which a single parameter defines a single item;

Figure 3 shows a more complex example, in which there are several items, each defined by one or more parameters;

Figure 4 illustrates that there may be different functions related to each drill-through path;

Figure 5 shows the necessary drill-through parameters for a situation where two business models must be integrated;

Figure 6 is a more complex example, relating three business models; and

Figure 7 is a further example, also showing the relationship with a Dimension Map.

Detailed Description of the Preferred Embodiment(s)

Typically, the invention is practiced within a network of computers and related equipment as illustrated in Figure 1. The data is stored in a data warehouse comprising files servers 100, 102, 104 and storage devices 106, 108, with related software applications, accessed from workstations 110, 111, 112 over a network 120.

Turning now to the Figure 2, a simple preferred embodiment is shown in which an item 210, representing a report column or parameter or some other expression from a drill-through source or target, has a parameter 200 exposed. The mapping 240 from the item also has two optional functions 220, 230 which may translate the data from the outside world (through the parameter) to the item and vice-versa. Strictly it is these optional processes which are known as mapping.

Several optional functions made feasible by other preferred embodiments are describe below. One important function already mentioned is the ability to translate or convert the data during the drill-through operation, and to select the actual conversion by means of an additional parameter. Earlier applications were only able to perform data conversion or manipulation of drill-through parameters within the report-producing application, and the functions were stored with the report schema. This meant that the report was often used specifically for one drill-through since the report column used in the context filter would only make sense for that particular drill-through. By enhancing the drill-through service so the input and output conversion functions are part of the drill-through model it is possible to decouple them from the report itself (or rather its description). In other words, any drill-through specific data conversions are encapsulated in the drill-through service, rather than in the report (and its schema). This is illustrated in the Figure 3, in which a drill-through source or target is generalized to a collection of parameters 300, 320, 340, 360 as shown each related (or mapped) over a path including a function 305, 325, 345, 365 respectively to one of the items 310, 330, 350. More than one parameter can map to a single drill-though item as is shown in the figure 3, where parameter 340 and parameter 360 both map to Item 350.

Another feature according to the present invention is a drill-through path. A drill-through path is a collection of source and target parameters. The drill-through path joins the source and target objects together. A single drill-though target can have many drill-through sources and vise-versa. These aspects are illustrated in Figure 3.

All of the various functions and mappings are captured and modeled using a single administration application. One preferred embodiment provides a single drill-through service that may be queried for drill-through information such as a list of targets from a given source or drill-through actions to be performed.

The various concepts that are used in the new drill-through scheme of the present invention will be described below.

The invention solves several problems found in earlier implementations. Since the drill-through source and targets are generalized as a collection of input and output parameters, it is not important to know in advance the actual drill-through target. For example it means that cubes built from the data extracted from database "A" can still drill-through to a report whose data comes from database "B". It is the modeler's responsibility to ensure that the drill-through paths from the source and targets are properly matched up and the appropriate conversion functions are added.

Provision of this new drill-through mechanism allows the drill-through model to be used in defining an Internet Uniform Resource Locator (URL) or a Hypertext Markup Language (HTML) FORM template, thereby providing for standard mechanisms for use in accessing data over the Internet. Therefore, in some preferred embodiments, drill-through to any web-based target makes use of the generic ability to add parameters to a URL or FORM. For example, in a case where a template is a string containing one or more predefined drill-through parameter placeholders, defined as <P1>, <P2>... etc., a drill-through target is defined as a URL, using the well-known construction:

http://myserver/path/app.cgi?params=(<P1>,<P2>,<P3>)

Considering the case of a report that contains 3 columns named C1, C2, and C3, a drill-through path is defined that maps this source with the URL target. In this case the drill-through path is (C1->P1, C2->P2, C3->P3). Drilling from the source report at a specific row to the target means that the row values for C1, C2 and C3 will be substituted into the URL at the P1, P2, and P3 placeholders, thereby producing the valid URL:

http://myserver/path/app.cgi?params=(C1, C2, C3)

The concept of defining one or more drill-through paths between meta-data models will be described below. A meta-data model is the model on which the reports are based. For example the Business Modeling Tool (BMT) is a meta-data modeling tool which is used by Report Net to build reports. In the simplest case, using the drill-through model of the present invention, a drill-through model designer defines a drill-through path from one report to another. The designer (user) may optionally define any drill-through parameters to be used in the context filter when navigation from one report to

another. In addition, the new drill-through scheme supports the concept of defining one or more drill-through paths between the different meta-data models. This gives the advantage that reports based on the meta-data models can make implicit use of the already defined drill-through paths. The invention therefore affords a generalized way of assigning drill-through paths between reports without having to explicitly define drill-through paths between all reports. This is done by providing a list of potential drill-through paths between model query items.

Various aspects of the use of the invention are more fully explained by reference to the following typical examples.

Considering a situation where there are two different meta-data models, one model is the "Sales" database and is used to allow report writer to generate reports on all sales related information. The other model is based on the "Human Resources" database and allows report writers to generate reports of Personal information.

In these circumstances it is often desirable to allow managers to drill-through from sales reports to personal reports in order to answer questions such; "Is this individual's salary commensurate with his sales record?"

Referring now to Figure 5, it will be described in more detail how these kinds of queries are supported using the present invention. In the Figure 5, the two models, Sales 500 and Human Resources 520 are shown, together with relationships (or drill-through paths) 540 represented by lines drawn between the related items P1 - P5 which are determined by a trained modeler experienced in the use of such systems. The Sales model includes two separate tables, namely SalesEmployee 502 and SalesMetrics 510, and the Human Resources Model includes a PersonalInfo table 521, and a SalaryInfo table 530. The relationships 540 represent the parameter mapping from one model to the other as previous described. In this case, the following mappings can be made:

P1 between [SalesEmployee].[EmployeeNum] 503 and
[PersonalInfo].[EmpNum] 522.

P2 between [SalesEmployee].[Manager] 505 and [PersonalInfo].[Name] 523.

P3 between [SalesEmployee].[EmployeeNum] 503 and
[SalaryInfo].[EmpNum] 531.

P4 between [SalesEmployee].[Name] 504 and [PersonalInfo].[Name] 523.

P5 between [SalesMetrics].[EmployeeNum] 511 and
[PersonalInfo].[EmpNum] 522.

Assume a source report based on the Sales model (Sales) with the following columns;

[SalesEmployee].[Manager], [SalesEmployee].[Name],
total([SalesMetric].[Revenue])

Further assume the target report is to be based on the Human Resources model (HR info) with the following report columns;

[PersonalInfo].[Name], [PersonalInfo].[Title], [PersonalInfo].[Salary],
[PersonalInfo].[LastRaiseDate]

It is not necessary to have parameters assigned to all of the query items. [PersonalInfo].[Title] 524, and [SalaryInfo].[LastRaiseDate] 532 are not assigned parameters in this example.

For the sake of simplicity it should be understood that parameter mapping functions are not required in this example. Their addition and effect will be obvious to one skilled in the art.

The report authoring tool asks the drill-through service for a list of potential drill-through paths that could be used to drill-through from the source report (Sales) 500 to the target report (HR Info) 520. The drill-through service employs the following algorithm to determine the paths:

1. Create a list of parameters (query items) from the source and target reports.
2. For each source parameter determine a parameter path that maps the parameter to the target. All parameter maps (or parameter paths defined by such maps) are collected as a single drill-through path
3. If more than one parameterised drill-through path points to the same target parameter then duplicate the drill-through path one for each duplicate target path. For example, in Figure 5 there are potentially two paths pointing to the same target [PersonalInfo].[Name] 523.As a result, two separate drill-through paths are created from the sources [SalesEmployee].[Name] 504 and [SalesEmployee].[Manager] 505. These paths are P2 and P4 540. This duplication prevents any conflicts when the filter is formed.

4. Continue splitting (duplicating paths) until all the parameter maps for each drill-through path point to unique target parameters.

In this example, after completion of the above algorithm, the following drill-through paths from among those possible 540 will be returned from the drill-through service:

- Drill-through #1 (P4) and
- Drill-through #2 (P2).

Using these paths, it is possible to drill-through from the sales report to the HR report and filter on either the salesperson's name or on the manager's name. The parameterised drill-through service of the present invention therefore allows the user to obtain the answer to either or both of the two questions:

1. "How much am I paying a sales person relative to their generated revenue?" and
2. "How much am I paying a manager relative to the total revenue of the sales people being managed?"

Only a single parameter mapping for each drill-through path is used here since only one parameter is matched from source to target. Generally, a drill-through path may contain any number of applicable parameter mappings.

Since it cannot be known in advance what parts of the report a model may use, a drill-through path is fully defined during the modeling phase. Therefore a collection of parameter mappings (P1- P5) 540 is provided from which the actual drill-through path can be built dynamically depending on what columns (parameters) are available in the source and target reports.

It is possible to have more than one drill-through path generated, as shown here, so a drill-through path selection must be made by the user.

Expanding on this general model of drill-through usage, it is also possible to define general drill-through paths from a meta-data model to specific reports. Figure 6 shows a Sales model 600 having two drill-though paths 630, 635 defined to two separate reports: an Order Detail Report 620 and an Employee Expenses Report 625.

One of the parameters of the "OrderDetail" drill-through path 630 maps on [SalesMetrics].[OrderNum] to report column "Order Number" 621. The "Expenses" drill-through path 635 contains a single parameter mapping on

[SalesEmployee].[EmployeeNum] to report column "Employee Number" 626. In some cases other parameters are available to be used in other instances of using the drill-through service. In some cases it is up to the drill-through target report to optimise away unnecessary filtering.

Once these drill-through services indicated by the paths 630, 635 have been defined, then any report that included either or both of the Sales Model items [SalesModel].[SalesEmployee].[Name] 603 and [SalesModel].[SalesMetrics].[OrderNumber] 605 can drill-through to the OrderDetail report 620. Similarly any report that includes a report column based on [SalesEmployee].[EmployeeNum] 602 can drill-through to the Employee Expenses 625 report.

Example: OLAP to Model Drill-through

This example describes the drill-through mapping to and from OLAP sources (via tools/applications exemplified by Cognos Powerplay and modeled with a tool such as Cognos Transformer) to models for relational reporting tools (such as Cognos ReportNet)

Referring next to the Figure 7, a cube 710 (represented in this diagram as being derived from a dimension map 700 by a suitable transformation tool 705) has a set of parameters which are the dimension levels. Each level is represented by (or exposed as) a parameter.

In one case a drill-through path 790 is defined from the cube 710 to the report OrderDetail Report 760. In this example two parameters mappings 761, 762 are included in the drill-through path 790.

In another case the cube parameters 710 are mapped to a model. This is a generalized case which is similar to the model to model case previously described. A set of paths 795 and their related parameters 781 are mapped between the cube 710 and the Model 780. As a consequence, any reports that are based on the model can drill into the cube assuming that the required parameters (columns) are included in the report. As a result significant savings are provided in terms of the number and the updating of drill-

through paths, when compared to the situation before the availability of parameterised drill-through paths.

While various embodiments of the present invention have been described above, it should be understood that they have been presented by way of example only, and not limitation. It will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined in the appended claims. Thus, the breadth and scope of the present invention should not be limited by any of the above-described exemplary embodiments, but should be defined only in accordance with the following claims and their equivalents.

The invention can be implemented in digital electronic circuitry or in computer hardware, firmware, and software or in combinations thereof. Apparatus of the present invention can be implemented in a computer program product tangibly embodied in a machine-readable storage device for execution by a programmable processor. The method of the present invention can be performed by a programmable processor executing a program of instructions to perform the functions of the invention by operating on input data and generating output.

What is claimed is:

1. A database interface for generating drill-throughs of various data cubes, derived from different report generating applications, comprising:

(a) means for accepting a request from a user for data;

(b) means for translating the request into a drill-through selected from a plurality of possible drill-through paths between a source and a target;

(c) means for applying one or more parameters to the selected drill-through path to produce a valid drill-through path and to transfer the requested data over the valid drill-through path to an application; and

(d) display means for displaying the requested data to the user.

2. A computer-based method for obtaining data from one or more compatible data sources for use within applications implementing a decision support system, the method comprising the steps of:

(a) in a business modeling tool before using a business intelligence application, modeling a mapping of data between a source and a target to produce one or more possible drill-through paths between the source and the target, each drill-through path having one or more parameters;

in the business intelligence application, by using a report authoring tool,

(b) accepting a request from a user for data;

(c) translating the request into a drill-through selected from the possible drill-through paths between the source and the target;

(d) applying one or more parameters to the selected drill-through path to produce a valid drill-through path and transferring the requested data over the valid drill-through path to an application; and

(e) displaying the requested data to a user.

3. The method of claim 2 wherein the translating step includes the steps of:

(a) creating a list of parameters (query items) from a source and target reports;

(b) for each source parameter, determining a parameter path that maps the parameter to the target and collecting them as a single drill-through path;

(c) if more than one parameterised drill-through path points to the same target parameter then duplicating the drill-through path one for each duplicate target path to avoid conflicts in forming the filter path; and

(d) continue splitting or duplicating the path until all the parameter maps for each drill-through path point to unique target parameters.

4. The method of claim 3 wherein the source and the target are each of types which are selected from a group consisting of report and model.

5. The method of claim 3 wherein the source is of a type selected from a group consisting of report and model and the target is a cube derived from a dimension map using a transformation tool.

6. The method of claim 3 wherein the drill-through path is defined by a Uniform Resource Locator (URL).

7. The method of claim 3 wherein the drill-through path is defined by an HTML FORM.

8. A computer-based system for obtaining data from one or more compatible data sources for use within applications implementing a decision support system, the system comprising the steps of:

(a) in a business modeling tool before using a business intelligence application,

means for modeling a mapping of data between a source and a target to produce one or more possible drill-through paths between the source and the target, each drill-through path having one or more parameters;

in the business intelligence application, by using a report authoring tool,

(b) means for accepting a request from a user for data;

(c) means for translating the request into a drill-through selected from the possible drill-through paths between the source and the target;

(d) means for applying one or more parameters to the selected drill-through path to produce a valid drill-through path and to transfer the requested data over the valid drill-through path to the application; and

(e) display means for displaying the requested data to a user.

9. The system of claim 8 wherein the means for translating further comprises:

(a) means for creating a list of parameters (query items) from a source and target reports;

(b) for each source parameter, means for determining a parameter path that maps the parameter to the target and collecting them as a single drill-through path; and

(c) means for duplicating the drill-through path one for each duplicate target path to avoid conflicts in forming the filter path.

10. The system of claim 8 wherein the source and the target are each of types which are selected from a group consisting of report and model.

11. The system of claim 8 wherein the source is of a type selected from a group consisting of report and model and the target is a cube derived from a dimension map using a transformation tool.

12. The system of claim 8 wherein the drill-through path is defined by a Uniform Resource Locator (URL).

13. The system of claim 8 wherein the drill-through path is defined by an HTML FORM.

14. An apparatus for obtaining data from one or more compatible data sources for use within applications implementing a decision support system, the apparatus comprising, a) in a business modeling tool, means for modeling a mapping of data between a source and

a target to produce one or more possible drill-through paths between the source and the target, each drill-through path having one or more parameters, b) in the business intelligence application, by using a report authoring tool, i) means for accepting a request from a user for data, ii) means for translating the request into a drill-through selected from the possible drill-through paths between the source and the target, iii) means for applying one or more parameters to the selected drill-through path to produce a valid drill-through path and to transfer the requested data over the valid drill-through path to the application; and iv) display means for displaying the requested data to a user.

15. Computer executable software code stored on a computer readable medium, the code for obtaining data from one or more compatible data sources for use within applications implementing a decision support system, the code comprising, a) in a business modeling tool, code for modeling a mapping of data between a source and a target to produce one or more possible drill-through paths between the source and the target, each drill-through path having one or more parameters, b) in the business intelligence application, by using a report authoring tool, i) code for accepting a request from a user for data, ii) code for translating the request into a drill-through selected from the possible drill-through paths between the source and the target, iii) code for applying one or more parameters to the selected drill-through path to produce a valid drill-through path and to transfer the requested data over the valid drill-through path to the application; and iv) code for displaying the requested data to a user.

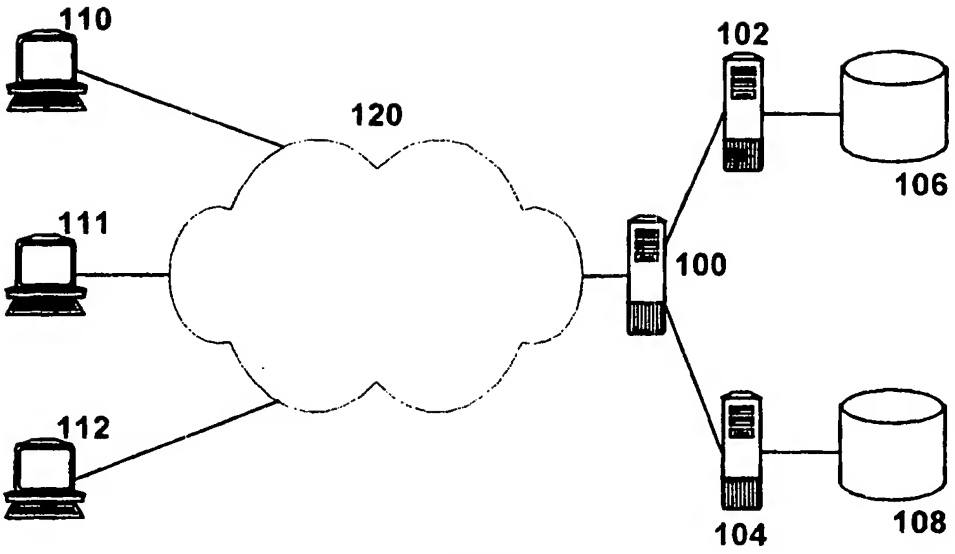
110
111
112
120
102
106
100
104
108

FIG. 1

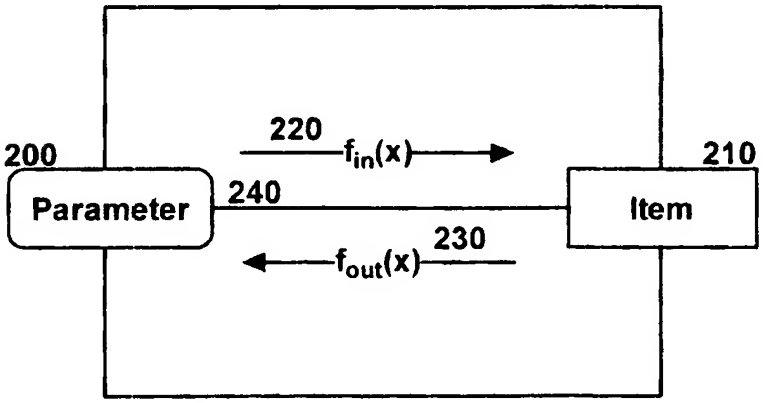
200
220
$f_{in}(x)$
210
Parameter
240
Item
230
$f_{out}(x)$

FIG. 2

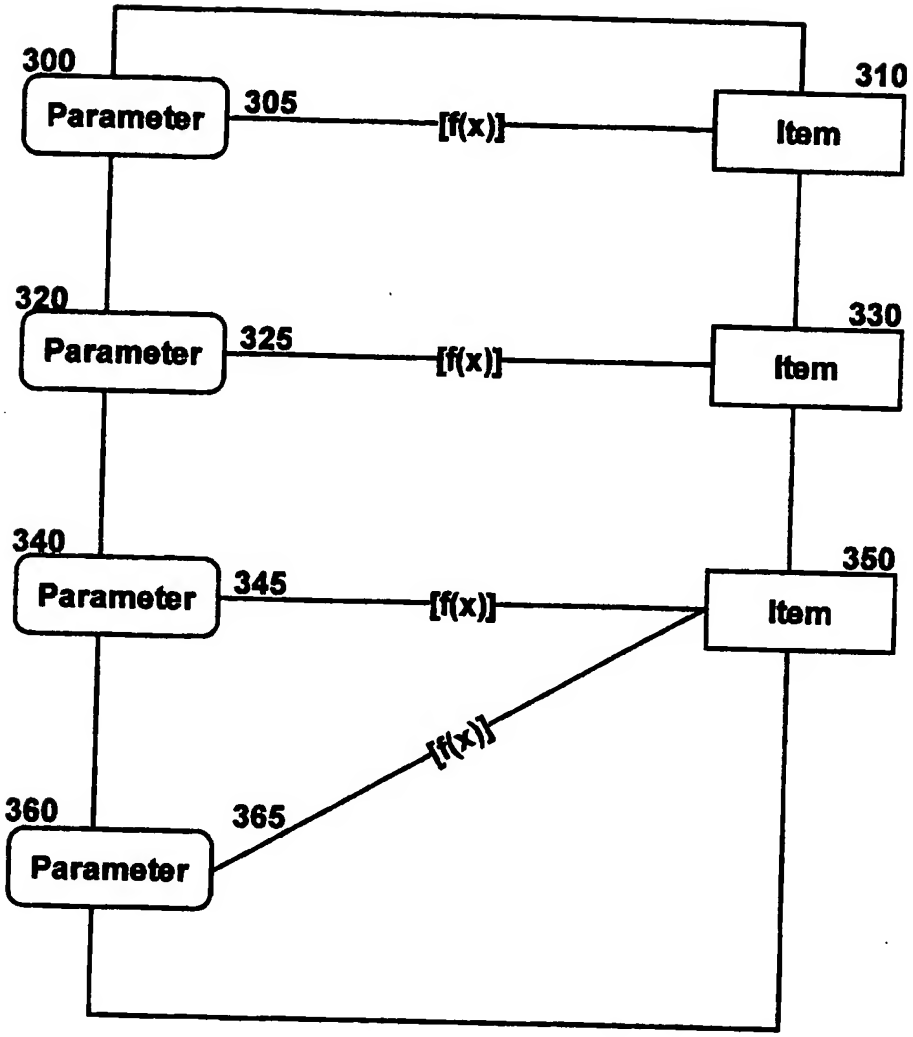
300
Parameter
305
[f(x)]
310
Item
320
Parameter
325
[f(x)]
330
Item
340
Parameter
345
[f(x)]
350
Item
[f(x)]
360
Parameter
365

FIG. 3

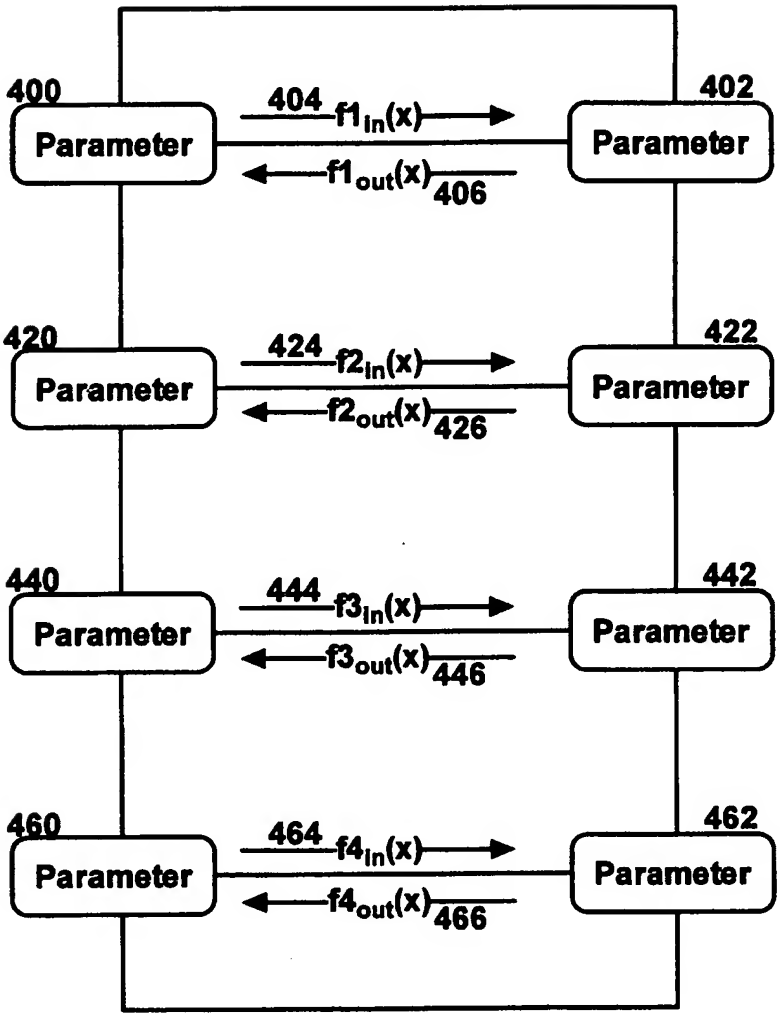
400
Parameter
404
f1In(x)
f1out(x)
406
402
Parameter
420
Parameter
424
f2In(x)
f2out(x)
426
422
Parameter
440
Parameter
444
f3In(x)
f3out(x)
446
442
Parameter
460
Parameter
464
f4In(x)
f4out(x)
466
462
Parameter

FIG. 4

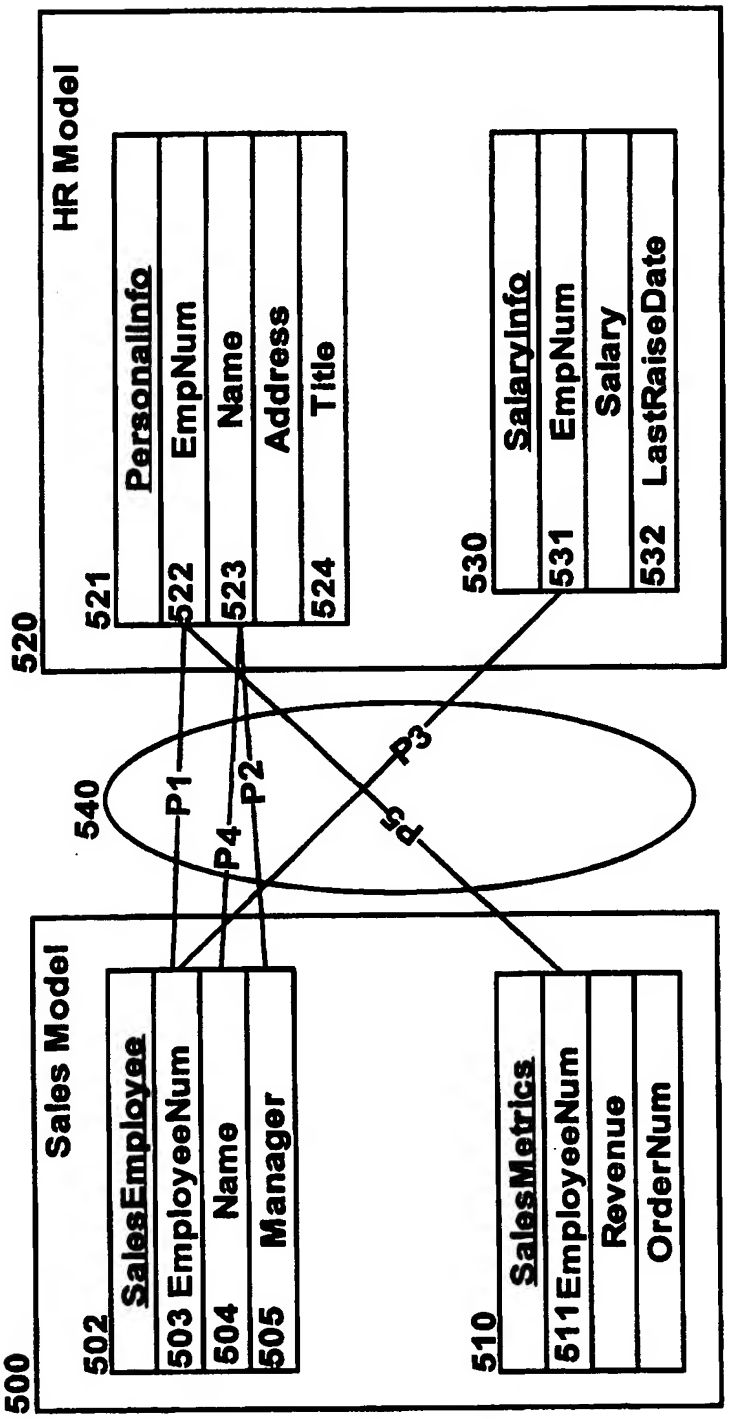
HR Model
520
PersonalInfo
521
EmpNum
522
Name
523
Address
524
Title
SalaryInfo
530
EmpNum
531
Salary
LastRaiseDate
532
540
P1
P2
P3
P4
P5
Sales Model
500
SalesEmployee
502
EmployeeNum
503
Name
504
Manager
505
SalesMetrics
510
EmployeeNum
511
Revenue
OrderNum

FIG. 5

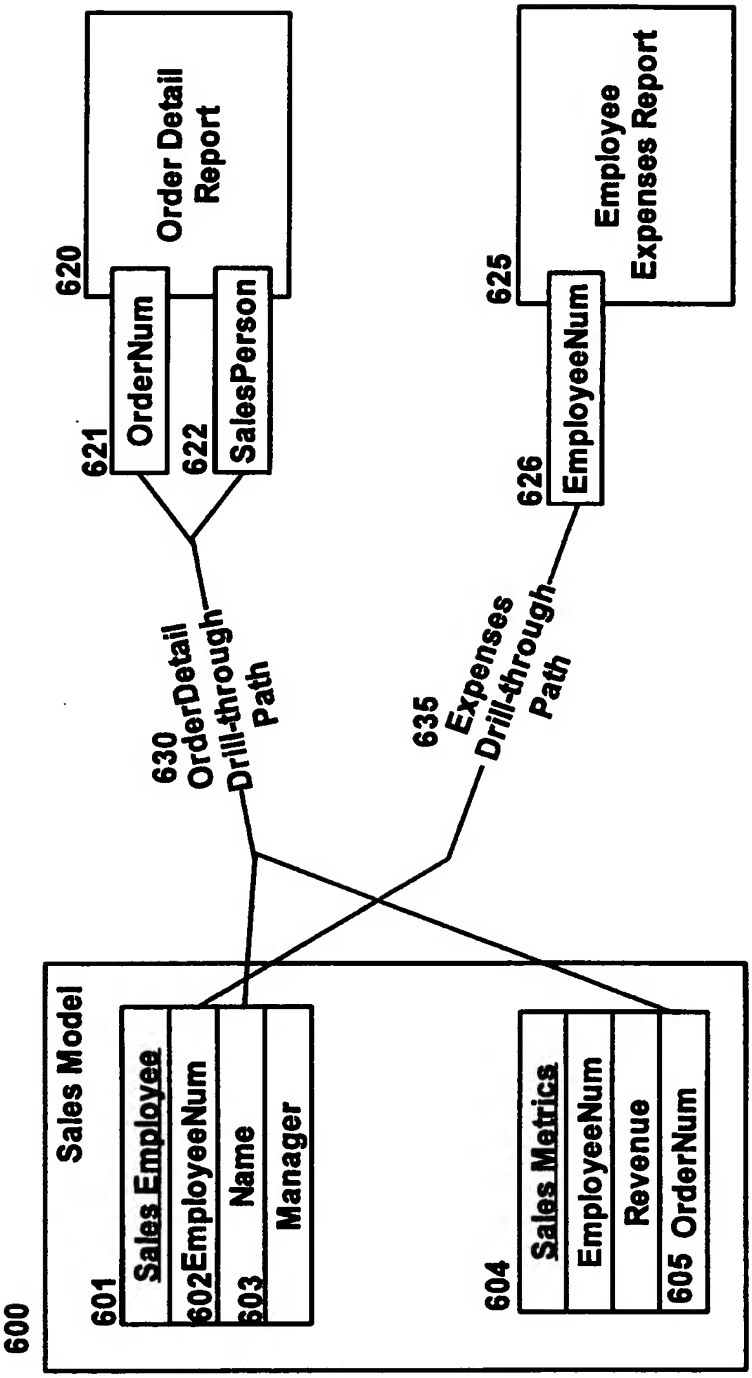
600
Sales Model
601
Sales Employee
602 EmployeeNum
603 Name
Manager
604
Sales Metrics
EmployeeNum
Revenue
605 OrderNum
620
Order Detail Report
621 OrderNum
622 SalesPerson
625
Employee Expenses Report
626 EmployeeNum
630 OrderDetail Drill-through Path
635 Expenses Drill-through Path

FIG. 6

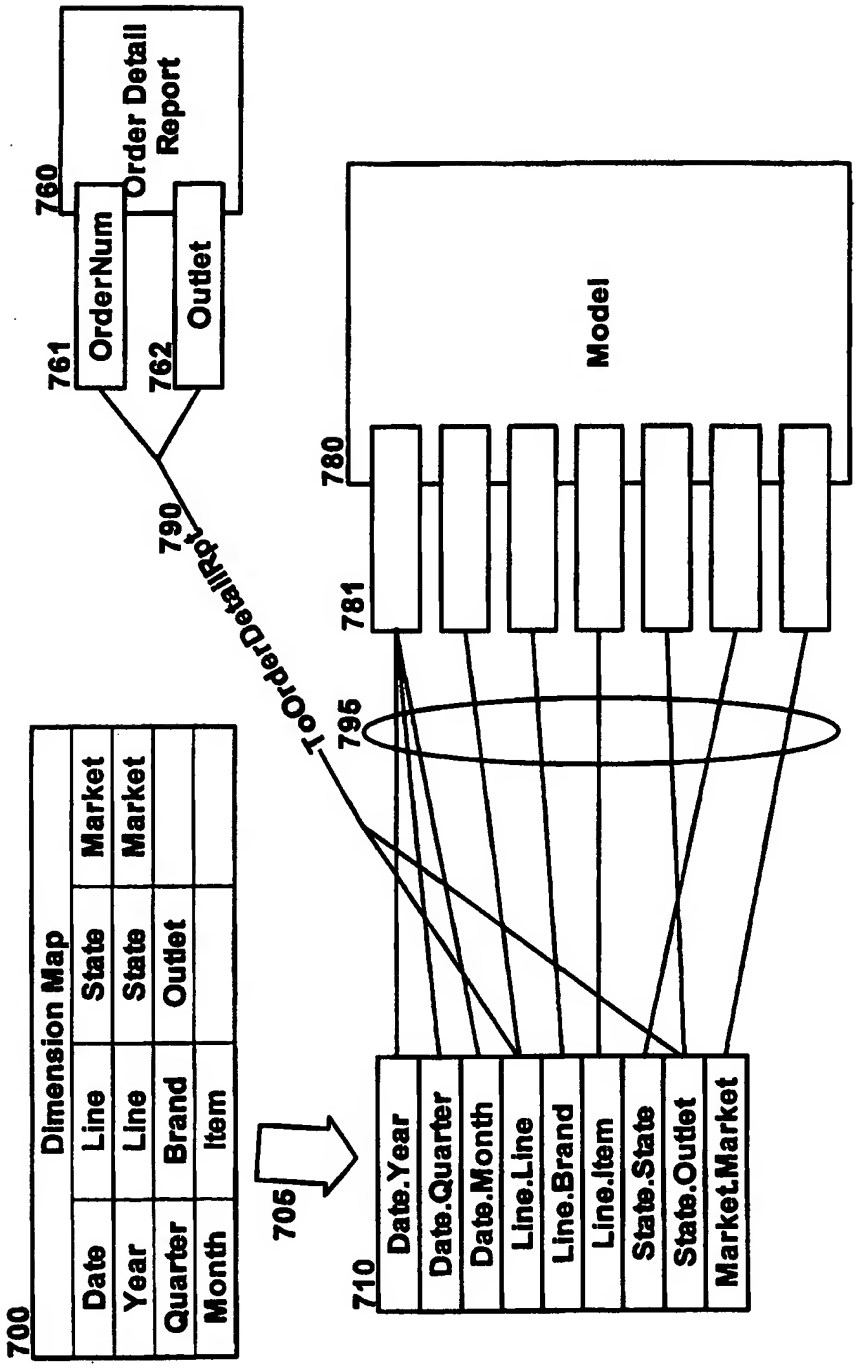
Order Detail Report
760
OrderNum
761
Outlet
762
790
ToOrderDetailRpt
Model
780
781
795
700
Dimension Map
Date
Year
Quarter
Month
Line
Line
Brand
Item
State
State
Outlet
Market
Market
705
710
Date.Year
Date.Quarter
Date.Month
Line.Line
Line.Brand
Line.Item
State.State
State.Outlet
Market.Market

FIG. 7